Chemistry 312 – Mole Practice Questions Name Key

Using the mole map in your chapter 11 Packet, complete the following calculations

Molar Mass. Remember that the molar mass is calculated by summing the products of the number of each atom by their mass (from the periodic table).

Example: Mass of one mole of $Cu(OH)_2$ = 1(Cu) + 2(O) + 2(H)=1(63.5g) + 2(16.0g) +2(1.0g)=97.5g

$Al(C_2H_3O_2)_3$ 204g Li_3PO_4 115.7g

$Ba(ClO_4)_2$ 363.3g $(NH_4)_2SO_4$ 132.1

Particle to Mole conversions. (1mole=6.02×10^{23})

How many water molecules are there in 14.8 moles of water?

$$14.8 \text{ moles } H_2O \left(\frac{6.02 \times 10^{23}}{1 \text{ mole}}\right) = 8.91 \times 10^{24} \text{ molecules } H_2O$$

How many moles are represented by 1.4×10^{13} formula units of NaCl?

$$1.4 \times 10^{13} \text{ fu NaCl} \left(\frac{1 \text{ mole}}{6.02 \times 10^{23}}\right) = 2.3 \times 10^{-11} \text{ fu NaCl}$$

Mass to Mole Problems (1mole=the molar mass of a substance) Hint: you have already calculated some molar masses above that you may use to do these problems.

What is the mass of 2.6 moles of barium perchlorate? ($Ba(ClO_4)_2$ from above)

$$2.6 \text{ mole } Ba(ClO_4)_2 \left(\frac{363.3 \text{ g}}{1 \text{ mole}}\right) = 945 \longrightarrow 950 \text{ g } Ba(ClO_4)_2$$

2SF

How many moles of ammonium sulfate are in 183g of ammonium sulfate?

$$183 \text{ g } (NH_4)_2SO_4 \left(\frac{1 \text{ mole}}{132.1}\right) = 1.39 \text{ moles } (NH_4)_2SO_4$$

Volume to Mole Problems (1mole of a gas at STP=22.4L)

What is the volume of 0.78moles of hydrogen gas at STP?

$$0.78 \text{ mol } H_2 \left(\frac{22.4 \text{ L}}{1 \text{ mol}}\right) = 17 \text{ L } H_2$$

How many moles of gas are in 17.6L of chlorine gas at STP?

$$17.6 \text{ L } Cl_2 \left(\frac{1 \text{ mol}}{22.4 \text{ L}}\right) = 0.786 \text{ mol } Cl_2$$

Chemistry 312 Chapter 11/12 Test Review

Conversions

1. How many formula units of $BaCl_2$ are there in 1.58 moles of $BaCl_2$?

$1.58\ \text{moles}\ BaCl_2 \left(\frac{6.02\times10^{23}\ \text{fu}}{1\ \text{mole}}\right) = 9.51\times10^{23}\ \text{fu of}\ BaCl_2$

2. Which has more atoms, 10 g of carbon or 10 g of calcium? 10g Carbon

$10g\,C\left(\frac{1\ \text{mole}}{12g}\right) = 0.8\ \text{mole C}$ $\quad 10g\,Ca\left(\frac{1\ \text{mol}}{40.1g}\right) = 0.2\ \text{mol Ca}$

3. What is the mass in grams of 9.7×10^{18} molecules of SiO_2?

$9.7\times10^{18}\ \text{molecules}\left(\frac{1\ \text{mole}}{6.02\times10^{23}\ \text{molecules}}\right)\left(\frac{60.1g}{1\ \text{mole}\ SiO_2}\right) = 0.00097g$ or $9.7\times10^{-4}g$

Percent Composition

4. What is the percent composition by mass of Boron in $V_2(B_4O_7)_5$?

$\frac{\text{mass of B in compound}}{\text{mass of compound}} \times 100 = \frac{20(10.8g)}{2(50.9g)+20(10.8g)+35(16.0g)}\times100 = 24.6\%$

Empirical Formula

5. What is the empirical formula of $H_{15}Br_3Cl_{12}$? H_5BrCl_4

6. Determine the empirical formula of a compound that contains 62.1% Carbon, 13.8% Hydrogen, and 24.1% nitrogen. $C_xH_yN_z$

$62.1g\,C\left(\frac{1\ \text{mol}}{12.0g}\right) = \frac{5.18\ \text{mol C}}{1.72}$ $\quad 13.8g\,H\left(\frac{1\ \text{mol}}{1g}\right) = \frac{13.8\ \text{mol H}}{1.72}$

$24.1g\left(\frac{1\ \text{mol}}{14.0g}\right) = \frac{1.72\ \text{mol N}}{1.72}$

C_3H_8N

Molecular Formula

7. Calculate the molecular formula of the compound whose molar mass is 60g that has an empirical formula of CH_4N.

$CH_4N = 1(12g) + 4(1g) + 1(14g) = 30g$

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{60}{30} = 2$ $\quad C_{1\times2}H_{4\times2}N_{1\times2} = C_2H_8N_2$

8. A sample of Hydrazine contains 28 g of nitrogen and 4 g of hydrogen. The molar mass of the molecule is 32g. What is the molecular formula of hydrazine? N_xH_y

$28g\,N\left(\frac{1\ \text{mole}}{14g}\right) = \frac{2\ \text{mol N}}{2}$

$4g\,H\left(\frac{1\ \text{mol}}{1g}\right) = \frac{4\ \text{mol H}}{2}$

N_1H_2 = empirical formula = 16g

$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{32g}{16} = 2$ $\quad N_{2\times1}H_{2\times2}$

N_2H_4

Additional Questions

9. What is the relationship between the molecular formula and the empirical formula of a compound?

The empirical formula is the reduced form of the molecular formula
→ lowest whole # ratio of atoms in a compound.

10. The percent compositions of the elements in a compound are 1.25% element 1, 19.86% element 2 and 78.89% element 3. If the coumpound is copper(I) hydroxide (CuOH), identify elements 1, 2 and 3.

#1 Hydrogen # 2 Oxygen #3 Copper